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Direct medical expenditures associated with Alzheimer's and related dementias (ADRD) in a nationally representative sample of older adults – an excess cost approach

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Abstract

Objective—To estimate the excess direct annual healthcare expenditures associated with Alzheimer's and related dementias(ADRD) among community-dwelling older adults in the United States.

Methods—This retrospective cross-sectional study compared the annual healthcare expenditures between elderly individuals aged 65 years and older with ADRD (n = 662) and without ADRD (n = 13,398) using data from the Medical Expenditure Panel Survey (MEPS) for the years 2007, 2009, 2011 and 2013. Adjusted total annual medical expenditures was estimated using generalized linear model with gamma distribution and log link in 2013 U.S. dollars. Adjusted inpatient, outpatient, emergency, home healthcare and prescription drug expenditures, were estimated using two-part logit-generalized linear regression models.

Results—The adjusted mean total healthcare expenditures were higher for the ADRD group as compared to the no ADRD group($14,508 vs. $10,096). Among those with ADRD, 34.3% of the expenditures were for home healthcare as compared to 4.4% among those without ADRD. Among users, the ADRD group had significantly higher home healthcare ($3,240 vs. $566) and prescription drug expenditures($3,471 vs. $2,471). There were no statistically significant differences in inpatient, emergency room and outpatient expenditures between the ADRD and no ADRD group.

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Disclosure statement

The authors declare that there is no conflict of interests regarding the publication of this paper.

Conclusion—ADRD in U.S. community-dwelling elders is associated with significant financial burden, primarily driven by increased home healthcare use.

Keywords

Alzheimer's dementia; direct medical expenditures; Medical Expenditure Panel Survey

Introduction

Alzheimer's and related dementias (ADRD) represent a growing public health crisis in the United States (US) affecting over 5 million US adults (Plassman et al., 2007); among older adults (age ≥65 years) the estimated prevalence of ADRD in 2012 was 8.8% (Langa et al., 2016). Alzheimer's disease is the most common form of dementia, comprising approximately 80% of ADRD cases (Alzheimer's Association, 2016). Nearly 14% of the older adults in the US aged 71 years and above are affected by ADRD (Plassman et al., 2007). With the rapid ageing of the US population, the prevalence of ADRD is projected to increase by more than threefold by 2050 affecting nearly 14 million adults, of which 7 million will be the oldest old aged 85 years and over (Hebert, Weuve, Scherr, & Evans, 2013).

The increasing prevalence of ADRD had resulted in escalating economic burden on the health care payers, families and the society at large. A study using a prospective cohort of Medicare beneficiaries aged 65 years and older found that individuals with ADRD incurred 18% higher Medicare expenditures as compared to a propensity-matched cohort of individuals without ADRD (Zhu et al., 2015). According to the latest reports by the Alzheimer's Association, Medicare and Medicaid cover more than two-thirds of the total health care expenditures associated with ADRD (Alzheimer's Association, 2016). Currently, one in every five Medicare dollars is being spent on adults with ADRD and this is likely to increase to one in every three dollars by 2050 (Alzheimer's Association, 2016). Therefore, understanding the total and the individual components of health care costs associated with ADRD is critical for future health care policy planning and resource allocation purposes (Kelley, McGarry, Gorges, & Skinner, 2015).

Several recent cost containment policy initiatives at the Federal and the State level have focused on shifting long-term institutional care to home and community-based services and maintain a patient with ADRD in home for a longer time because institutionalization is the major driver of cost of ADRD (Eiken, Sredl, Burwell, & Saucier, 2015). Such efforts underscore the importance of generating more recent and comprehensive assessment of direct medical expenditures among the community-dwelling population in the US. The Medical Expenditure Panel Survey (MEPS) is an appropriate data-set for such evaluation as it is nationally representative of the US community-dwelling non-institutionalized civilian population and captures medical expenditures across all the major categories of health care services. Although, previous studies have used nationally representative surveys such as Health and Retirement Study (HRS) (Hurd, Martorell, Delavande, Mullen, & Langa, 2013) and Medicare Current Beneficiary Survey (Yang, Zhang, Lin, Clevenger, & Atherly, 2012), till date no studies have estimated the direct medical expenditures associated with ADRD

using MEPS. Therefore, the primary objective of the current study was to provide estimates of annual ADRD-associated utilization and expenditures among community-dwelling non-institutionalized older adults using data from MEPS. We compared not only the incremental total annual health care expenditures but also expenditures across major categories of health care services (inpatient, outpatient, emergency department, home health care and prescribed medications) in those with vs. without ADRD.

Conceptual framework

The conceptual framework for this study was adapted from the Andersen's Expanded Behavioral Model which posits that health services utilization by an individual is a function of predisposing factors (e.g. age, sex and race), enabling factors (e.g. marital status, education and poverty status), need factors (e.g. chronic conditions and health status) and personal health practices (e.g. physical activity, obesity and smoking) (Andersen, 1995).

Methods

Study design

A retrospective cross-sectional study design was used.

Study sample

The study sample in the current study comprised individuals aged 65 years and older, who were alive during the study period (2007–2013, $N = 14,645$). We also excluded individuals who had zero total health care expenditures ($n = 5$ in the ADRD group and $N = 580$ in the No ADRD group).

In our study sample, only five individuals with ADRD had zero total health care expenditures and 580 individuals without ADRD had zero total health care expenditures. Because of the small sample size of ADRD group with zero expenditures, we were unable to compare individuals with and without health care expenditures by ADRD status. However, the exclusion of individuals with zero total medical expenditures did not significantly change the excess ADRD expenditures.

Data

We used data from the MEPS, a large-scale survey of the civilian non-institutionalized population in the US. The Household Component of MEPS collects information on demographic characteristics, medical conditions, health status, utilization of health care services, charges and payments, access to care, health insurance coverage, income, education and employment on all household members (Agency for Healthcare Research and Quality, 2015). The survey captures medical conditions of the respondents based on the verbatim text; these texts are converted into International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes by professional coders (Agency for Healthcare Research and Quality, 2014). MEPS uses a probability weighted complex multistage survey design with primary sampling units, strata and person level sampling weights. We pooled four years of data (2007, 2009, 2011 and 2013) to have sufficient

sample size, and used data from alternate years to avoid including two observations per individual.

Measures

Dependent variables—The dependent variables for this study were per capita annual direct medical utilization and expenditures, both overall and by service category. In the MEPS, total annual direct medical expenditures were calculated as the sum of inpatient, outpatient, emergency, dental, home health, vision, prescription drugs and other medical supplies and equipment expenditures paid by third-party payers and out-of-pocket spending by the respondent and/or family. The outpatient visit variable included both medical provider visits in office-based settings and clinics as well as hospital outpatient visits. MEPS distinguishes components of total expenditures by type of service such as inpatient, outpatient, emergency department, home health, dental, vision, prescription and other expenditures. We also compared the different components of utilization and expenditures between the ADRD and the No ADRD groups. All expenditures were adjusted for medical services inflation to 2013 US dollars (USD).

Key explanatory variable: ADRD versus No ADRD—Elderly individuals with ADRD were identified from the medical conditions file using the ICD-9-CM codes 290.XX, 291.XX, 294.XX or 331. XX. Elderly individuals without these diagnosis codes were considered to have 'No ADRD.'

Other explanatory variables—Other explanatory variables comprised *predisposing characteristics* such as sex (male, female), race (Whites, African-American, other racial minorities) and age in years (65–74 years, 75 years and older); *enabling factors* such as marital status (married, widow, separated/divorced, never married), family poverty status (not poor, poor), health insurance status (public, private) and usual source of care (yes, no); and *need factors* such as the total number of chronic conditions (0, 1–3, >3 conditions, drawn from a list of 12 conditions that commonly co-occur with ADRD including diabetes, heart disease, hypertension, stroke, chronic obstructive pulmonary disease, asthma, thyroid, cancer, arthritis, depression and anxiety), perceived physical health status (excellent/very good, good and fair/poor) and perceived mental health status (excellent/very good, good and fair/poor). We also adjusted for personal health practice factors, including BMI (underweight/normal, overweight, obese), smoking status (current smoker, other, missing) and exercise (three times per week, no exercise).

Statistical analyses

Chi-square tests were used to determine the statistically significant differences between ADRD and No ADRD groups. Unadjusted utilization and expenditures were compared between the two groups using Student's Independent *t*-tests.

Negative binomial regression model—As annual home health visits, inpatient visits, inpatient days, emergency visits and outpatient visits are all non-negative count data, we used negative binomial regression to assess the adjusted differences in number of visits by ADRD status after controlling for predisposing factors, enabling characteristics, need factors

and personal health care practices. We selected negative binomial regression model rather than Poisson, zero-inflated Poisson, zero-inflated negative binomial because a graphical comparison of predicted and observed counts of utilization variables was similar under the negative binomial regression models. This method has been used in previous published studies for model selection of count variables in complex survey data because statistical tests for assessing the fit of count data models such as Likelihood Ratio test, Wald test and Vuong test are not applicable with complex survey data (Meraya & Sambamoorthi, 2016; Wiener, Long, & Jurevic, 2015).

Modeling of expenditures outcomes in health care data is associated with typical challenges such as high positive skewness, kurtosis, non-linearity in response to explanatory variables, heteroscedasticity and non-trivial fraction of zero outcomes (many observations with zero expenditures) that lead to the generation of biased estimates from Ordinary Least Square (OLS) regression modeling (Duan, Manning, Morris, & Newhouse, 1983; Mihaylova, Briggs, O'Hagan, & Thompson, 2011). OLS regression based on log-transformed expenditures reduces the problem of skewness, but does not avoid bias due to the re-transformation of cost from log scale to the original scale (Gregori et al., 2011; Mihaylova et al., 2011). *Generalized Linear Model (GLM)* is an attractive alternative to OLS regressions on log-transformed expenditures because it corrects for heteroscedasticity and avoids the re-transformation bias (Gregori et al., 2011; Mihaylova et al., 2011). Therefore, in this study we used GLM with log link and gamma family distribution to estimate the adjusted differences in health care expenditures by ADRD status after controlling for predisposing factors, enabling characteristics, need factors and personal health care practices.

Two-part regression model—Individuals with zero expenditures in inpatient, outpatient, emergency, home health, prescription drugs and other services were not excluded. For these services, due to the substantial number of individuals with zero expenditures, two part models were conducted. In the two-part regression model, the first part was a logistic regression estimating the probability of positive expenditures. In the second part, a GLM with log link and gamma distribution was used to analyze positive expenditures in the subsample with positive expenditures as derived from the logistic regression. The expected expenditures are then obtained by multiplying the predictions from the two parts (Mihaylova et al., 2011).

Counterfactual prediction technique—Deriving marginal effects in non-linear multiplicative model such as GLM is complex because re-transformation to estimate cost in original dollar values reintroduces the problem of covariate imbalance (Deb, Manning, & Norton, 2013; Glick, Doshi, Sonnad, & Polsky, 2014). To avoid such complexity, the incremental effect of any binary variable needs to be calculated using the method of recycled prediction (Basu & Rathouz, 2005; Deb et al., 2013; Glick et al., 2014). Therefore, to estimate the excess expenditures attributable to ADRD, we used the recycled prediction or counterfactual prediction technique rather than simply comparing the expenditures of the ADRD versus No ADRD groups. We did not use a matched control because the method of recycled prediction adjusts for covariate imbalance. The recycled prediction technique avoids the problem of covariate imbalance in the two groups by creating an identical

covariate structure or identical individual characteristics in both ADRD and No ADRD groups. For this technique, we coded each participant as if s/he were in the ADRD group and calculated the predicted expenditures from the GLM results. Then, we coded each participant as if s/he were in the No ADRD group and calculated the predicted expenditure from the GLM results. The excess medical expenditure due to ADRD was then calculated based on the difference between the groups with ADRD vs. that without No ADRD. The excess health care utilization associated with ADRD was also estimated using the method of recycled prediction. Confidence intervals were obtained using 2000 bootstrap replications using the percentile method. To account for the complex design of MEPS, we conducted all analyses with survey procedures in SAS 9.4 (SAS Institute Inc, 2015) and used survey design features with STATA 14 (StataCorp, 2015).

Results

The characteristics of the study population are summarized in Table 1. Less than 5% (4.1%) of the non-institutionalized older adults (≥65 years) were diagnosed with ADRD. A significantly higher percentage of older adults with ADRD were 75 years and older (84.6% vs. 43.3%), female (66.3% vs. 56.4%), widowed (51.1% vs. 27.2%), had education less than high school (31.6% vs. 17.5%), poor (47.4% vs. 32.3%), reported fair/poor perceived health status (48.1% vs. 20.1%), reported fair/poor perceived mental health status (54.7% vs. 8.4%), and had three or more chronic comorbid conditions (37.5% vs. 25.1%) as compared to those without ADRD.

In our study sample (Table 2), older adults with ADRD had higher average unadjusted mean home health care visits (53.37 vs. 3.65; $p < 0.0001$) and prescriptions drug counts (45.34 vs. 28.94; $p < 0.0001$) as compared to those without ADRD. Table 3 compares the unadjusted average health care expenditure between the ADRD and the No ADRD group. The average unadjusted total annual expenditures of older adults with ADRD were 1.7 times higher than that of their counterparts without ADRD ($17,032 vs. $10,072; $p < 0.0001$). The average home health care expenditures of older adults with ADRD were 13.1 times higher than those without ADRD ($5840 versus $444; $p < 0.001$). Among elderly with ADRD, 34.3% of the total expenditures were for home health care as compared to 4.4% among those without ADRD. Table 3 also presents total expenditures and components among users of the services. Among users of home health care, the average home health care expenditures of older adults with ADRD were 2.35 times higher than those without ADRD ($14,110 versus $6004; $p < 0.001$).

After adjusting for predisposing, enabling, need and personal health practice variables, older adults with ADRD had significantly higher adjusted annual paid home health care visits (64 vs. 7) and prescription refills (39 vs. 30) as compared to those without ADRD (Table 4). The adjusted total annual expenditures, home health expenditures and pharmacy expenditures were significantly higher in the ADRD group as compared to the No ADRD group (Table 5). The adjusted annual per-person mean total health care expenditures in the ADRD group was $14,508 (95% CI $14,368–$14,650), which was significantly higher than the No ADRD group $10,096 (95% CI $ 9,999–$10,195), an incremental expenditure of $4,412 (95% CI $ 4369–$4455). The incremental home health care and prescription drug expenditures for

older adults with ADRD were $2852 (95% CI $2805–$2903) and $973 (95% CI $963–$982), respectively as compared to the No ADRD group. However, there were no statistically significant differences in inpatient, emergency room and outpatient expenditures between the ADRD and No ADRD groups. The sum of the adjusted mean expenditures for the different healthcare service categories do not add up to the total expenditures because the adjusted estimates have been derived from separate regression models.

There were significant differences in total health care expenditures by age group. For example, elderly individuals who were 75 years and older had 10% higher total health care expenditures compared to individuals in the age group 65–74 years. However, the differences by age group were not significant for the specific types of health care providers.

Discussion

The study used a nationally representative sample of community-dwelling non-institutionalized older adults aged 65 years and older to provide the most recent and comprehensive estimates to date of the direct incremental annual medical expenditures associated with ADRD. Our results revealed that older adults with ADRD have a significantly higher total annual medical expenditure as compared to individuals without ADRD after adjusting for predisposing, enabling, need and personal health practices. The excess cost associated with ADRD varied widely across the major categories of the health care services. However, our results are not directly comparable to the direct medical expenditures derived by using the HRS data as dementia was ascertained in the HRS using a different approach based on determination of probable dementia using a statistical prediction model. Also, our estimated expenditures for ADRD are considerably lower than those of Hurd et al., likely because Hurd et al.'s estimates were based on an older population (adults ≥70 years of age) with dementia and included nursing home care expenditures, which is the largest cost component in the care of older adults with ADRD. In contrast, our study focused on community-dwelling seniors aged 65 years and above with ADRD and did not include long-term care expenditures. Previous research has shown that the total direct medical expenditures are 20.8% lower for patients residing in home versus those residing in an institutional setting (Zhu et al., 2006). The study by Hurd et al. using the HRS data reported that the incremental annual nursing home expenditures among older adults aged 70 years and above $13, 876 (2010 US dollars).

Consistent with published literature (Schaller, Mauskopf, Kriza, Wahlster, & Kolominsky-Rabas, 2015), we found that home health care use was the major driver of excess expenditures associated with ADRD and not the inpatient, outpatient and emergency visit expenditures. As the ADRD population represents a population with substantial disability, they require extensive supervision and assistance due to their limitations of activities of daily living and instrumental activities of daily living, cognitive impairment and behavioral issues.

The results from this study will provide baseline estimates for medical expenditures in a large, nationally representative sample of community-dwelling patients with ADRD which can be used in future cost-effectiveness research. Although it is intuitive that an additional comorbid condition will incur additional medical utilization and costs, it is important to

understand the precise estimates of excess medical costs and utilization attributable to ADRD which would inform health care policy analysis, simulation, resource allocation and planning. Cost-based research is necessary since there is no cure for ADRD and the costs of care are increasing exponentially (Alzheimer's Association, 2016). Specifically, research on in-home care for patients with ADRD is crucial as the number of patients being treated in-home in the US continues to rise. In-home care ranges from non-medical companion services to skilled care. Given that availability and costs of these services can vary widely from region to region in the US, many federal initiatives have increased funding for ADRD services and coordinated efforts to improve outcomes of ADRD treatment (ASPE, 2016; Hoffman, 2014). US federal funding for ADRD research has also increased by more than $350 million with the passage of the 2016 federal budget. In addition, as of 2014, 33 states have developed ADRD plans in an effort to coordinate treatment elements between family members, caregivers, researchers and other stakeholders (Hoffman, 2014).

The findings of this study should be interpreted considering its strengths and limitations. The strengths of this study include the use of a nationally representative data-set; adjustment for a comprehensive array of potential confounders of cost such as demographic, socioeconomic characteristics, physical and mental health status, health practices and chronic health conditions; and cost estimation using a two-part model that employed GLM and the recycled prediction method. However, there are several potential limitations of this study. First, as the data from MEPS is self-reported, it is subject to recall bias, non-response bias, attrition and under-representation of high-cost cases (Aizcorbe et al., 2012; Zuvekas & Olin, 2009). Second, we did not control for the duration and severity of ADRD, as this information is unavailable in MEPS and as we have used a control population. Third, we only estimated the direct incremental medical cost associated with ADRD and did not consider the indirect expenditures associated with receiving informal care by caregivers and cost of lost productivity of caregivers. Finally, we could not distinguish between types of home health care services other than that payments were made to home health agencies or independent home health care providers.

Conclusion

In summary, the present study provides estimates of annual direct medical expenditures associated with ADRD among the non-institutionalized elderly population aged 65 years and older in the US. Our results confirmed that ADRD imposes a significant economic burden to society, with home health care being the major cost driver. These cost estimates can be used to inform both future resource allocation and economic models such as cost-benefit and cost-effectiveness analysis for evaluation of new care coordination and care management programs for community-dwelling US elders with ADRD.

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Table 1

Descriptive statistics of older adults (≥65 years) with and without Alzheimer's disease and related dementias (ADRD) Medical Expenditure Panel Survey (2007, 2009, 2011 and 2013).

	ADRD		No ADRD		
	N	Weighted %	*N*	Weighted %	Sig
All	662	100.0	13,398	100.0	
Gender					
Female	425	66.3	7655	56.4	***
Male	237	33.7	5743	43.6	
Race					
White	337	71.5	8,323	80.0	***
African-American	145	12.0	2275	8.2	
Other	180	16.5	2800	11.8	
Age in years					
65–75 years	122	15.4	7803	56.7	***
75 and older	540	84.6	5595	43.3	
Marital status					
Married	208	33.1	7130	55.6	***
Widow	353	51.1	3760	27.2	
Separated/divorced	75	12.7	1910	13.2	
Never married	26	3.1	598	3.9	
Education					
Less than high school	280	31.6	3299	17.5	***
High school	209	38.2	4195	32.9	
More than high school	126	25.6	5426	46.9	
Poverty status					
Poor	371	47.4	5354	32.3	***
Not poor	291	52.6	8044	67.7	
Supplementary insurance					
Yes	197	36.4	6511	55.0	***
No	465	63.6	6887	45.0	

	ADRD		No ADRD		
	N	Weighted %	*N*	Weighted %	Sig
Perceived physical health status					
Excellent/very good	115	19.4	5677	47.1	***
Good	179	32.5	4498	32.8	
Fair/poor	368	48.1	3222	20.1	
Perceived mental health status					
Excellent/very good	103	16.8	7586	60.5	***
Good	181	28.6	4436	31.2	
Fair/poor	378	54.7	1376	8.4	
Body mass index					
Underweight/normal	286	46.0	4334	33.6	***
Overweight	217	34.3	5010	38.4	
Obese	144	19.8	3803	28.0	
Smoking status					
Current smoker	47	7.1	1172	8.6	
Other	553	85.7	11,218	86.4	
Physical activity					
Three times per week	120	19.9	5881	46.0	***
No exercise	539	80.1	7432	54.0	
Number of chronic conditions					
0	34	5.6	1175	8.8	***
1–3	392	56.9	8923	66.1	
>3	236	37.5	3300	25.1	

Note: Based on 14,010 (662 ADRD and 13,348 No ADRD) community-dwelling elderly individuals aged 65 years and older who were alive during the calendar year. Missing categories for education, smoking status, BMI and physical activity are not displayed. Asterisks represent significant group differences by ADRD status based on chi-square tests.

*** $p < .001$;

** $.001 \leq p < .01$;

* $.01 \leq p < .05$.

Table 2

Unadjusted average per-person annual health care utilization among older adults (≥65 years) with and without Alzheimer's disease and related dementias (ADRD) from the Medical Expenditure Panel Survey (2007, 2009, 2011 and 2013).

Among all						
	ADRD (1.6 million)			**No ADRD (37.1 million)**		
	N	**Mean**	**SE**	***N***	**Mean**	**SE**
Home health visits***	662	53.37	7.41	13,398	3.65	0.27
Inpatient visits	662	0.32	0.03	13,398	0.22	0.00
Inpatient days	662	1.88	0.25	13,398	1.21	0.06
Emergency visits *	662	0.43	0.04	13,398	0.24	0.00
Outpatient visits	662	11.5	0.84	13,398	12.35	0.19
Prescription count***	662	45.34	1.93	13,398	28.94	0.41
Among users of specific services						
	ADRD			No ADRD		
	N	Mean	SE	*N*	Mean	SE
Home health visits***	300	128.95	11.16	1053	49.4	2.81
Inpatient visits	160	1.4	0.06	2135	1.38	0.02
Inpatient days	160	8.28	0.81	2135	7.46	0.32
Emergency visits	200	1.44	0.08	2405	1.4	0.02
Outpatient visits	629	12.29	0.87	12,781	12.83	0.19
Prescription count***	637	47.83	1.92	12,672	30.53	0.42

Note: Based on 14,010 (662 ADRD and 13,348 No ADRD) community-dwelling elderly individuals aged 65 years and older who were alive during the calendar year. Asterisks represent significant group differences by the presence of ADRD based on '*t*-tests'. SE = standard error.

*** $p < .001$;

** $.001 \leq p < .01$;

* $.01\ p < .05$.

Table 3

Unadjusted average per person annual health care expenditures (2013 US. dollars) among older adults (≥65 years) with and without Alzheimer's disease and related dementias (ADRD) from the Medical Expenditure Panel Survey (2007, 2009, 2011 and 2013).

Among all						
	ADRD (1.6 million)			**No ADRD (37.1 million)**		
	N	**Mean ($)**	**SE**	***N***	**Mean ($)**	**SE**
Total ***	662	17,032	1236	13,398	10,072	210
Home health ***	662	5840	1138	13,398	444	30
Inpatient	662	3811	428	13,398	3233	155
Emergency *	662	380	69	13,398	222	11
Outpatient	662	2569	293	13,398	3107	72
Prescription ***	662	3811	222	13,398	2433	49
Other	662	622	90	13,398	633	18
Among individuals with non-zero expenditures						
	ADRD			No ADRD		
	N	Mean ($)	SE	*N*	Mean ($)	SE
Total ***	662	17,032	1236	13,398	10,072	210
Home health ***	300	14,110	2221	1055	6004	285
Inpatient	160	16,770	1348	2132	20,034	737
Emergency	186	1,371	236	2299	1335	55
Outpatient	625	2774	312	12,765	3233	75
Prescription ***	637	4020	224	12,671	2567	51
Other	340	1084	145	7447	1033	27

Note: Based on 14,010 (662 ADRD and 13,348 No ADRD) community-dwelling elderly individuals aged 65 years and older who were alive during the calendar year. Asterisks represent significant group differences by the presence of ADRD based on 't-tests'. SE = Standard Error.

*** $p < .001$;

** $.001 \leq p < .01$;

* $.01 \leq p < .05$

Table 4

Adjusted average per-person health care utilization among older adults (≥65 years) with and without Alzheimer's disease and related dementias (ADRD) from the Medical Expenditure Panel Survey (2007, 2009, 2011 and 2013).

	ADRD (1.6 million)		No ADRD (37.1 million)		Incremental difference	
	Mean	**95% confidence interval**	**Mean**	**95% confidence interval**	**Mean**	**95% confidence interval**
Home health visits ***	64.31	(62.18–66.59)	6.52	(6.31–6.75)	57.79	(55.88–59.84)
Inpatient visits	0.21	(0.20–0.21)	0.24	(0.23–0.24)		
Inpatient days	1.50	(1.47–1.53)	1.39	(1.37–1.42)		
Emergency room visits	0.28	(0.27–0.28)	0.26	(0.25–0.26)		
Outpatient visits	11.19	(11.11–11.26)	11.74	(11.65–11.82)		
Prescriptions ***	39.13	(38.77–39.50)	30.37	(30.08–30.65)	8.77	(8.68–8.85)

Note: Based on 14,010 (662 ADRD and 13,348 No ADRD) community-dwelling elderly individuals aged 65 years and older who were alive during the calendar year. All utilizations are adjusted for age, sex, race, marital status, education, income, insurance type, mental health status, physical health status, number of chronic conditions, body mass index categories, physical activity and smoking. Confidence intervals are based on 2000 bootstrap replications using the percentile method.

*** $p < .001$;

** $.001 \leq p < .01$;

* $.01 \leq p < .05$.

Table 5

Adjusted total and incremental average per-person annual health care expenditures (2013 US dollars) among elderly individuals (≥65 years) with and without Alzheimer's disease and related disorders (ADRD) from the Medical Expenditure Panel Survey (2007, 2009, 2011 and 2013).

	ADRD (1.6 million)		No ADRD (37.1 million)		Incremental difference	
	Mean ($)	**95% confidence interval**	**Mean ($)**	**95% confidence interval**	**Mean ($)**	**95% confidence interval**
Total ***	14,508	(14,368–14,650)	10,096	(9,999–10,195)	4412	(4369–4455)
Home health ***	3413	(3353–3478)	561	(549–575)	2852	(2805–2903)
Inpatient	2652	(2617–2686)	3356	(3313–3399)		
Emergency	268	(264–271)	241	(238–244)		
Outpatient	2525	(2503–2546)	2952	(2927–2976)		
Prescription ***	3447	(3414–3481)	2475	(2451–2499)	973	(963–982)
Other ***	312	(308–317)	140	(139–143)	172	(170–174)

Note: Based on 14,010 (662 ADRD and 13,348 No ADRD) community-dwelling elderly individuals aged 65 years and older who were alive during the calendar year. All expenditures are adjusted for age, sex, race, marital status, education, income, insurance type, mental health status, physical health status, number of chronic conditions, body mass index categories, physical activity and smoking. Confidence intervals are based on 2000 bootstrap replications using the percentile method.

*** $p < .001$;

** $.001 \leq p < .01$;

* $.01 \leq p < .05$.